1. A method for analyzing jitter in a signal comprising:

buffering the signal to form a sequence of signal vectors; and

for each signal vector of the sequence of signal vectors:

calculating a time interval error function of the signal vector;

transforming the time interval error function using a discrete Fourier transform to produce a time interval error spectrum;

calculating an average time interval error spectrum as an average of the magnitude of the time interval error spectrum;

calculating an average power spectral density function as an average of the power time interval error spectrum;

estimating parameters of the signal jitter from the average time interval error spectrum and the average power spectral density function; and

reporting the parameters of the signal jitter.

2. A method in accordance with claim 1, wherein at least one of the average time interval error spectrum and the average power spectral density function is calculated as a running average.

3. A method in accordance with claim 1, wherein estimating parameters of the signal jitter comprises:

identifying frequencies Fp corresponding to amplitude peaks in the time interval error spectrum;

calculating a modified spectrum at the frequencies Fp having the amplitude of average time interval error spectrum and the phase of the time interval error spectrum;

calculating a function *w* as an inverse discrete Fourier transform of the modified spectrum;

calculating a running histogram *hw* of the function *w*; and

calculating the peak-to-peak value of the histogram *hw*.

4. A method in accordance with claim 3, wherein identifying frequencies Fp

comprises identifying the frequencies for which peaks in the average time interval error spectrum are above a noise floor.

5. A method in accordance with claim 3, wherein identifying frequencies Fp comprises identifying the frequencies for which peaks in the average power spectral density function are above a noise floor.

6. A method in accordance with claim 1, wherein estimating parameters of the signal jitter comprises:

identifying frequencies Fp corresponding to amplitude peaks in the time interval error spectrum;

subtracting the amplitude squared of the average time interval error spectrum from the average power spectral density function at the frequencies Fp to obtain a modified power spectral density function; and

calculating an RMS random jitter value RJ_rms as the square root of the integral of the modified power spectral density function.

7. A method in accordance with claim 6, wherein estimating parameters of the signal jitter further comprises:

calculating a Gaussian distribution function *hg* having a standard deviation of RJ_rms; and

calculating a peak-to-peak value RJ_pp of the Gaussian distribution function *hg* for a given error rate.

8. A method in accordance with claim 7, wherein estimating parameters of the signal jitter further comprises:

calculating a modified spectrum at the frequencies Fp having the amplitude of average time interval error spectrum and the phase of the time interval error spectrum;

calculating a function *w* as an inverse discrete Fourier transform of the modified spectrum;

calculating a running histogram *hw* of the function *w*;

convolving *hw* and *hg* to produce a total jitter function *ht*; and

calculating a peak-to-peak value TJ_pp of the total jitter function *ht*.

9. A method in accordance with claim 8, wherein estimating parameters of the signal

jitter further comprises:

calculating a bathtub curve from *ht* and a bit interval value.

10. A method in accordance with claim 1, wherein calculating a time interval error function of the signal vector comprises:

buffering a reference timing signal to obtain a reference signal vector;

detecting reference transition times in the reference signal vector;

detecting signal transition times in the signal vector; and

calculating the time differences between reference transition times and signal transition times.

11. A method in accordance with claim 1, wherein calculating a time interval error function of the signal vector comprises:

detecting signal transition times in the signal vector;

estimating ideal transition times from the signal transition times; and

calculating the time differences between ideal transition times and signal transition times.

12. A method in accordance with claim 1, wherein calculating the average of the time interval error spectrum comprises calculating a weighted sum of the time interval error spectrum of the signal vector and time interval error spectra of a plurality of previous signal vectors.

13. A method in accordance with claim 12, wherein the weighted sum is an exponentially weighted sum and is calculated recursively.

14. A method in accordance with claim 1, wherein calculating the average of the power spectral density function comprises calculating a weighted sum of the power spectral density function of the signal vector and power spectral density functions of a plurality of previous signal vectors.

15. A method in accordance with claim 14, wherein the weighted sum is an exponentially weighted sum and is calculated recursively.

16. A method in accordance with claim 1, wherein the signal is a data signal, the method further comprising:

identifying an initial data pattern function of a first signal vector in the

sequence of signal vectors;

for each signal vector following the first signal vector:

calculating a data pattern function, *d*;

skewing the data pattern function, *d*, to time-align it with the initial data pattern function;

calculating a time interval error function, *y*, time-aligned with the initial data pattern function;

calculating an average time interval error function *y'* as a running average of the skewed time interval error function y;

calculating a running histogram *hy* of the average time interval error function *y'*;

calculating a first running mean as the running mean of those *y'* values associated with rising edges of the data pattern function, *d*;

calculating a second running mean as the running mean of those *y'* values associated with falling edges of the data pattern function, *d*; and

calculating a duty cycle distortion value as a magnitude difference between the first and second running means.

17. A method in accordance with claim 16, wherein estimating parameters of the signal jitter further comprises:

calculating a Gaussian distribution function *hg* having a standard deviation of RJ_rms; and

calculating a peak-to-peak value RJ_pp of the Gaussian distribution function *hg* for a given error rate.

18. A method in accordance with claim 17, wherein estimating parameters of the signal jitter further comprises:

calculating a modified spectrum at the frequencies Fp having the amplitude of average time interval error spectrum and the phase of the time interval error spectrum;

calculating a function *w* as an inverse discrete Fourier transform of the modified spectrum;

calculating a running histogram *hw* of the function *w*;

convolving *ht*, *hw* and *hg* to produce a total jitter function *ht*; and

calculating a peak-to-peak value TJ_pp of the total jitter function *ht*.

19. A method in accordance with claim 1, wherein the signal is a data signal, the method further comprising:

identifying an initial data pattern function of a first signal vector in the sequence of signal vectors;

for each signal vector following the first signal vector:

calculating a data pattern function, *d*;

skewing the data pattern function, *d* to time-align it with the initial data pattern function;

calculating a time interval error function, *y*, time-aligned with the initial data pattern function;

calculating an average time interval error function *y'* as a running average of the time interval error function y;

calculating a running histogram *hy* of the average time interval error

function y';

calculating a first running peak-to-peak value of those y' values associated with rising edges of the data pattern function, d;

calculating a second running peak-to-peak value of those y' values associated with falling edges of the data pattern function, d; and

calculating an intersymbol interference value as a mean of the first and second running peak-to-peak values.

20. A method in accordance with claim 1, wherein the signal is a data signal, the method further comprising:

identifying an initial data pattern function of a first signal vector in the sequence of signal vectors;

for each signal vector following the first signal vector:

calculating a data pattern function, d;

skewing the data pattern function, d to time-align it with the initial data pattern function;

calculating an first time interval error function, y, time-aligned with the initial data pattern function; and

calculating an average time interval error function y' as a running average of the first time interval error function y;

wherein calculating a time interval error function of the signal vector comprises:

subtracting y' from y to form a second average time interval error function; and

calculating the time interval error function by interpolating the second modified average time interval error function to estimate the average time interval error function in intervals having no signal transition.

21. A system for analyzing jitter in a signal comprising:

a data buffer for storing a signal vector x;

a time interval error calculator for calculating a time interval error z of the signal vector x;

a Fourier transformer for calculating a time interval error spectrum Z as a discrete Fourier transform of the time interval error z;

a power spectrum averager for calculating an average power spectrum P' from an average of the amplitude squared of the time interval error spectrum Z;

a spectrum averager for calculating an average time interval error spectrum Z' from an average of the magnitude of the time interval error spectrum Z;

a deterministic jitter analyzer for estimating parameters of the deterministic jitter from the average time interval error spectrum and the average power spectrum; and

a random jitter analyzer for estimating parameters of the random jitter from the average time interval error spectrum and the average power spectrum.

22. A system in accordance with claim 21, wherein the deterministic jitter analyzer is operable to estimate a histogram *hw* of a deterministic component of the time interval error function and the random jitter analyzer is operable to estimate a histogram *hg* of a random component of the time interval error function, and further comprising:

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a total jitter analyzer, responsive to the histograms *hw* and *hg* and operable to estimate parameters of the total jitter.

23. A system in accordance with claim 22, wherein the parameters of the total jitter include at least one of a bathtub curve and a bit interval value.

24. A system in accordance with claim 21, wherein the parameters of the deterministic jitter include the peak-to-peak value of the deterministic jitter.

25. A system in accordance with claim 21, wherein the parameters of the random jitter include the peak-to-peak value and the root mean square value of the random jitter.

26. A system for analyzing jitter in a data signal comprising:

a data buffer for storing a signal vector x;

a time interval error calculator for calculating a time interval error y of the signal vector x;

a data pattern calculator for calculating a data pattern function d of the signal vector x;

a signal averager for calculating a running average y', of the time interval error y; and

a data analyzer, responsive to the average time interval error y' and the data pattern function d and operable for estimate the duty cycle distortion and the intersymbol interference of the data signal;

wherein the time interval error y and the data pattern function d are time-aligned to an initial data pattern function.

27. A system in accordance with claim 26, wherein the data analyzer is further operable to calculate a histograms hy of the average time interval error function y'.

28. A system in accordance with claim 27, further comprising:

a modified time interval error calculator, responsive to the average time interval error y' and operable to estimate a modified time interval error function z;

a Fourier transformer for calculating a time interval error spectrum Z as a discrete Fourier transform of the modified time interval error z;

a power spectrum averager for calculating an average power spectrum P' from a running of the amplitude squared of the time interval error spectrum Z;

a spectrum averager for calculating an average time interval error spectrum Z' from a running average of the magnitude of the time interval error spectrum Z;

a deterministic jitter analyzer for estimating parameters of the deterministic jitter from the average time interval error spectrum and the average power spectrum; and

a random jitter analyzer for estimating parameters of the random jitter from the average time interval error spectrum and the average power spectrum.

29. A system in accordance with claim 28, wherein the deterministic jitter analyzer is operable to estimate a histogram *hw* of a deterministic component of the time interval error function and the random jitter analyzer is operable to estimate a histogram *hg* of a random component of the time interval error function, and further comprising:

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a total jitter analyzer, responsive to the histograms *hw* and *hg* and operable to estimate parameters of the total jitter.

30. A system in accordance with claim 29, wherein the parameters of the total jitter include at least one of a bathtub curve and a peak-to-peak value of the total jitter.

31. A system in accordance with claim 29, wherein the parameters of the deterministic jitter include the peak-to-peak value of the deterministic jitter.

32. A system in accordance with claim 28, wherein the parameters of the random jitter include the peak-to-peak value and the root mean square value of the random jitter.

33. A computer readable medium storing a sequence of program instructions for controlling a computer to perform an analysis of jitter a signal, the sequence of program instructions including:

a plurality of instructions for calculating a time interval error function of a signal vector;

a plurality of instructions for transforming the time interval error function using a discrete Fourier transform to produce a time interval error spectrum;

a plurality of instructions for calculating an average time interval error spectrum as a running average of the magnitude of the time interval error spectrum;

a plurality of instructions for calculating an average power spectral density function as a running average of the power time interval error spectrum;

a plurality of instructions for estimating parameters of the signal jitter from the average time interval error spectrum and the average power spectral density function; and

a plurality of instructions for reporting the parameters of the signal jitter.

34. A computer readable medium in accordance with claim 33, wherein the plurality of instructions for estimating parameters of the signal jitter comprises:

a plurality of instructions for identifying frequencies Fp corresponding to amplitude peaks in the time interval error spectrum;

a plurality of instructions for calculating a modified spectrum at the frequencies Fn having the amplitude of average time interval error spectrum and the phase of the time interval error spectrum;

a plurality of instructions for calculating a function *w* as an inverse discrete Fourier transform of the modified spectrum;

a plurality of instructions for calculating a running histogram *hw* of the function *w*; and

a plurality of instructions for calculating a deterministic jitter value DJ_pp as the peak-to-peak value of the histogram *w*.

35. A computer readable medium in accordance with claim 33, wherein the plurality of instructions for estimating parameters of the signal jitter comprises:

a plurality of instructions for identifying frequencies Fp corresponding to amplitude peaks in the time interval error spectrum;

a plurality of instructions for subtracting the amplitude squared of the average a plurality of instructions for time interval error spectrum from the average power spectral density function at the frequencies Fp to obtain a modified power spectral density function; and

a plurality of instructions for calculating an RMS random jitter value RJ_rms as the square root of the integral of the modified power spectral density function.

36. A computer readable medium in accordance with claim 35, wherein the plurality of instructions for estimating parameters of the signal jitter further comprises:

a plurality of instructions for calculating a Gaussian distribution function *hg* having a standard deviation of RJ_rms; and

a plurality of instructions for calculating a peak-to-peak value RJ_pp of the Gaussian distribution function *hg*.

37. A computer readable medium in accordance with claim 36, wherein the plurality of instructions for estimating parameters of the signal jitter further comprises:

a plurality of instructions for calculating a modified spectrum at the frequencies Fn having the amplitude of average time interval error spectrum and the phase of the time interval error spectrum;

a plurality of instructions for calculating a function *w* as an inverse-discrete Fourier transform of the modified spectrum;

a plurality of instructions for calculating a running histogram *hw* of the function *w*;

a plurality of instructions for convolving *hw* and *hg* to produce a total jitter function *ht*; and

a plurality of instructions for calculating a peak-to-peak value TJ_pp of the total jitter function *ht*.

38. A computer readable medium in accordance with claim 37, wherein the plurality of instructions for estimating parameters of the signal jitter further comprises:

a plurality of instructions for calculating a bathtub curve from *ht* and a bit interval value.

39. A system for analyzing jitter in a signal comprising:

means for receiving a signal vector x;

means for calculating a time interval error spectrum Z as a discrete Fourier transform of the time interval error of the signal vector x;

means for averaging the amplitude squared of the time interval error spectrum Z to produce an an average power spectrum P';

means for averaging the magnitude of the time interval error spectrum Z to produce an average time interval error spectrum Z';

means for estimating deterministic jitter parameters from the average time interval error spectrum Z' and the average power spectrum P'; and

means for estimating random jitter parameters from the average time interval error spectrum Z' and the average power spectrum P'.

40. A system for analyzing jitter in a data signal comprising:

means for receiving a sequence of signal vectors;

computation means operable to:

calculate a data pattern function d of each signal vector x of the sequence of signal vectors;

calculate a time interval error y of each signal vector x of the sequence of signal vectors; and

calculate an average time interval error y', of the time interval error y for the sequence of signal vectors; and

calculate estimates of the duty cycle distortion and the intersymbol interference of the data signal from the average time interval error y' and the data pattern function d; and

means for outputting the estimates of the duty cycle distortion and the intersymbol interference of the data signal,

wherein the time interval error y and the data pattern function d are time-aligned to an initial data pattern function.

41. A system in accordance with claim 40, wherein the computation means is further operable to calculate a histograms hy of the average time interval error function y'.

42. A system in accordance with claim 41, wherein the computation means is further operable to calculate a modified time interval error dependent upon the average time interval error y' and to calculate a modified time interval error function z, and further comprising:

means for calculating a time interval error spectrum Z as a discrete Fourier transform of the modified time interval error function z;

means for averaging the amplitude squared of the time interval error spectrum Z to produce an an average power spectrum P';

means for averaging the magnitude of the time interval error spectrum Z to produce an average time interval error spectrum Z';

means for estimating deterministic jitter parameters from the average time interval error spectrum Z' and the average power spectrum P'; and

means for estimating random jitter parameters from the average time interval error spectrum Z' and the average power spectrum P'.